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Cestode Parasites of Some Taiwanese Shrews

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ABSTRACT—Five new species of hymenolepidid and one new species of dilepidid cestodes were obtained through the examination of 15 shrews belonging to four species of four genera, collected in three regions of Taiwan from October 7 to 9, 1986. *Vampirolepis formosana* sp. n. from *Anourosorex squamipes yamashinai* is related to but differs from *V. montana* and *V. molus* in the shape of rostellar hooks. *Vampirolepis magnihamata* sp. n. from *A. squamipes yamashinai* is related to but differs from *V. macroscelidarum, V. neomidis* and *V. stefanskii* in the size and shape of rostellar hooks. *Vampirolepis sunci* sp. n. from *Suncus myosurus swinhoei* is related to but differs from *V. amamiensis* in the size and shape of rostellar hooks, and the size of embryonic hooks. *Vampirolepis sessilihamata* sp. n. from *S. myosurus swinhoei* is related to but differs from *V. bahli* in the shape of rostellar hooks. *Vampirolepis gracilistrobila* sp. n. from *S. myosurus swinhoei* is related to but differs from *V. notoensis* in the size of strobila, the number of rostellar hooks, the position of genital pores and the form of ovary. *Choanotaenia (Choanotaenia) tubirostellata* sp. n. from *A. squamipes yamashinai* is related to but differs from *C. (C.) sciuricola* in the size of rostellum, the number of rostellar hooks and the size of onchospheres.

INTRODUCTION

The cestode parasites of shrews in Taiwan have been unknown the most part except one by Olsen and Kuntze (1978) [1], who described *Staphylocystis* (*Staphylocystis*) *suncuensis* from *Suncus murinus* collected at Wu Shi, Nantou Hsien. So far no attempt have been made to study the cestode parasites of shrews, although they are quite common in Taiwan. It is the purpose of this paper to give a preliminary note of the cestode parasites obtained from shrews in Taiwan. More complete information on these helminths will be published at a later date.

MATERIALS AND METHODS

A total of 15 shrews were captured by trap at Nantou and Taoyuan Hsiens from October 7 to 9, 1986. The shrews were autopsied immediately after capture and their intesinal tracts were fixed in Carnoy's fluid and brought to Japan. After being soaked in 45% acetic acid for five hr for expanding, they were cut open in 70% alcohol and examined for cestodes. The cestodes obtained were stored in 70% alcohol. The morphological features of scoleces, eggs and a part of mature segments were observed under the interference contrast light microscope. The strobilae were stained with alcohol-hydrochloride-carmine, dehydrated in alcohol, cleared in xylene, and mounted in Canada balsam. Measurements are given in millimetes.

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RESULTS

Localities of the shrews and their cestodes obtained are shown in Figure 1 and Table 1. The cestodes found were as follows: *Vampirolepis formosana* sp. n., *V. magnihamata* sp. n., *V. sunci* sp. n., *V. sessilihamata* sp. n., *V. gracilistrobila* sp. n. and *Choanotaenia* (*Choanotaenia*) *tubirostella* sp. n..

Fig. 1. Map showing the collection sites of shrews. For the locality, see Table 1.

Vampirolepis Spassky, 1954
Vampirolpeis formosana sp. n.
(Figs. 2–4)

One Yamashinai's mole-shrew, *Anourosorex squamipes yamashinai,* captured at Kunyan, Lenai Hsiang, Nantou Hsien on October 7, 1986, contained two specimens of the present new species. They were fully mature, but not gravid.

Description: Small-sized hymenolepidid; strobila length 15–19 and 0.4–0.6 width. Metamerism distinct, craspedote, margins slightly serrate. Scolex nearly tetragonal, 0.140–0.273 long by 0.154–0.175 wide. Rostellum oval or spherical, 0.070–0.091 long by 0.063–0.091 wide, armed with a single row of 28–30 chela-shaped hooks. Hooks measuring 0.021; handle comparatively long, guard round at its end, remarkably shorter than blade; blade sharp at its end, curved toward guard. Rostellar sac oval, 0.120–0.126 long by 0.019–0.098 wide. Suckers discoid, unarmed, 0.084–0.091 in diameter. Neck absent.

Genital pores unilateral, located a little anterior to middle of segment margins. Testes three in number, subspherical, 0.056–0.063 by 0.028–0.035, situated in the posterior field of segment and arranged triangularly, one poral and two aporal. Vagina opening in genital atrium, posterior to cirrus sac, passing behind cirrus sac, gradually expanding into voluminous seminal receptacle measuring 0.035–0.053 long by 0.025 wide. Ovary transversely elongated, 0.070–0.091 across, situated in anterior field of segment. Vitelline gland compact, 0.035–0.063 long by 0.028–0.035 wide, situated near midline in space between poral and aporal testes, posterior to ovary.

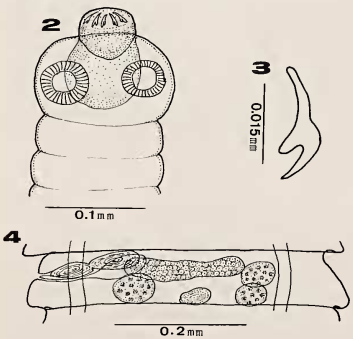
Host: *Anourosorex squamipes yamashinai* Kudoda.

Site of infection: Small intestine.

Locality and date: Kunyan, Lenai Hsiang, Nantou Hsien; October 7, 1986.

Type specimen: Holotype: NSU Lab. Coll. No. 8901.

Remarks: The present new species closely resembles *Vampirolepis montana* Crusz and Sanmugasunderam, 1971 from *Suncus murinus montanus* [2] and *V. molus* Srivastava and Capoor, 1979 from *Crocidura murianus* [3] in the number of rostellar hooks, furthermore, it closely resembles the latter in the length of rostellar hooks (Table 2). However, it differs from the above-mentioned two cestodes in the shape of rostellar hooks (Fig. 5).



Figs. 2–4. *Vampirolepis formosana* sp. n. 2: Scolex. 3: Rostellar hook. 4: Mature segment, ventral view.

Fig. 5. Rostellar hooks of closely related species. A: *V. montana.* B: *V. olus.*

TABLE 1. Shrews examined and their cestode parasites in Taiwan in 1986

Serial No. of locality in Fig. 1	Locality	Date	Shrew species	No. of shrew examined	No. of shrew infected		Cestode species
1	Kunyan, Lenai Hsiang Nantou Hsien	Oct. 7	*Soriculus fumidus*	2	0		
			Anourosorex squamipes yamashinai	3	1		*Vampirolepis formosana* s. n.
					1		*V. magnihamata* sp. n.
2	Tsuifeng, Lenai Hsiang, Nantou, Hsien	Oct. 8	*A. squamipes yamashinai*	6	6		*Choanotaenia* (*Choanotaenia*) *tubirostellata* sp. n.
					1	*	*C.(C.)tubirostellata* sp. n.
						*	*V. magnihamata* sp. n.
3	Kuanin Tsun, Kuanyin Hsiang, Taoyuan Hsien	Oct. 9	*Crocidura tanakae*	1	1		juvenile (unidentified)
			Suncus myosurus swinhoei	3	1	*	*V. sessilihamata* sp. n.
						*	*V. gracilistrobila* sp. n.
					1		*V. sunci* sp. n.

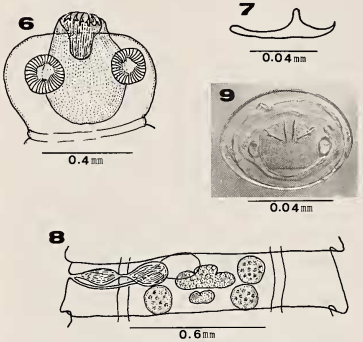
* double infection

TABLE 2. Comparison of closely related species armed with 24–32 rostellar hooks

Species	Rostellar hook		Host species
	No.	length	
V. montana	24–28	0.0553–0.065	*Suncus murinus nontanus*
V. molus	26–32	0.015–0.019	*Crocidura murianus*
V. formosana sp. n.	28–30	0.021	*Anourosorex squamipes yamashinai*

Vampirolepis magnihamata sp. n.
(Figs. 6–9)

On October 7, 1986, one Yamashina's mole-shrew, *A. squamipes yamashinai,* was captured at Kunyan, Lenai Hsiang, Nantou Hsien. The shrew was found infected with six mature specimens of this cestode.



Figs. 6–9. *Vampirolepis magnihamata* sp. n. 6: Scolex. 7: Rostellar hook. 8: Mature segment, ventral view. 9: Egg.

Description: Medium-sized hymenolepidid; worm length 46–60; maximum width 1.2–1.7. Metamerism distinct, margins serrate. Segments wider than long. Scolex 0.154–0.277 long by 0.140–0.207 wide, set off from strobila. Rostellum mushroom-shaped, 0.207–0.387 long by 0.083–0.161 wide, armed with a single row of 16-18 hooks measuring 0.063–0.070. Hook handle slightly long; guard round at its end, making a right angle with handle; blade remarkably curved and sharp at its end. Rostellar sac large and pyriform, 0.434-0.448 long by 0.343–0.350 wide. Suckers discoid, 0.154–0.277 long by 0.140–0.207 wide. Neck absent.

Genital pores unilateral, located at anterior 1/3 of segment margins. Testes three in number, spherical or oval, arranged triangularly. Cirrus sac pyriform, 0.175–0.245 long by 0.063–0.070 wide, extending beyond longitudinal osmoregulatory canals. Internal seminal vesicle 0.091–0.112 long by 0.056–0.063 wide. External seminal vesicle oval, 0.210–0.238 long by 0.077–0.091 wide. Vagina opening in genital strium, extending medially, then enlarging, and forming voluminous seminal receptacle measuring 0.196–0.245 long by 0.190–0.245 wide. Ovary transversely elongate, trilobate in mature segment, 0.077–0.084 wide. Vitelline gland weakly developed, bilobate, 0.056–0.098 by 0.042–0.056, situated near middle in space between poral and aporal testes, just posterior to ovary. Eggs oval or spherical, 0.070–0.081 by 0.053–0.063, surrounded by four thin envelopes, with smooth surface. Onchospheres spherical, 0.039 by 0.028–0.030; embryonic hooks 0.011 long.

Host: *Anourosorex squamipes yamashinai* Kuroda.

Site of infection: Small intestine.

Localities and date: Kunyan, Lenai Hsiang, Nantou Hsien: October 7, 1986 and Tsuifeng, Lenai Hsiang, Nantou, Hsien: October 8, 1986.

Type specimen: Holotype: NSU Lab. Coll. No. 8902: Paratypes: No. 8903.

Remarks: About 20 species of the *Vampirolepis* have been recorded from the Soricidae. Of these, the species armed with 15–22 rostellar hooks are *V. macroscelidarum* (Baer, 1926) [4], *V. neomidis* (Baer, 1931) [5] and *V. stefanskii* (Zarnowdki, 1954) [6]. The present new species differs from any of them in the size and shape of rostellar hooks (Table 3 and Fig. 10).

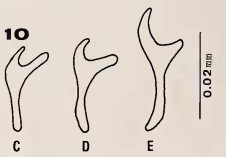


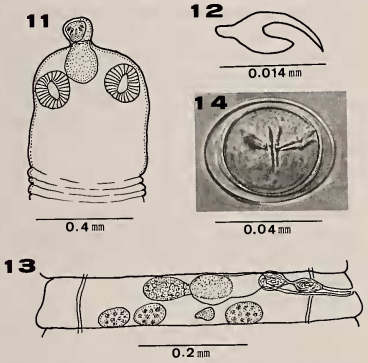
Fig. 10. Rostellar hooks of closely related species. C: *V. macroscelidarum*. D: *V. neomidis*. E: *V. stefanskii*.

Vampirolepis sunci sp. n.
(Figs. 11–44)

On October 9, 1986, three brown musk shrews, *Suncus myosurus swinhoei* were captured at Kua-

Table 3. Comparison of closely related species armed with 15–22 rostellar hooks

Cestode species	Rostellar hook		Host species
	No.	length	
V. macroscelidarum	20	0.019	*Macroscelides brachyrynchus*
V. neomidis	18	0.022	*Neomys fodiens*
V. stefanskii	15–22	0.028–0.032	*Sorex araneus*
V. magnihamata sp. n.	16–18	0.063–0.070	*Anourosorex squamipes yamashinai*



Figs. 11–14. *Vampirolepis sunci* sp. n. 11: Scolex. 12: Rostellar hook. 13: Mature segment, dorsal view. 14: Egg.

nyin Tsun, Kuanyin Hsiang, Taoyuan Hsien. One of them harbored a specimen of this cestode.

Description: Small-sized hymenolepidid: mature strobila length 18 and maximum width 0.6. Metamerism distinct, margins serrate. Segments wider than long. Scolex 0.415 long by 0.484 wide, not demarcated from neck. Rostellum pyriform, 0.070 long by 0.055 wide, armed with a single circle of 16 thorn-shaped hooks measuring 0.014 long. Hook handle short; guard bluntly round at its end, shorter than blade; blade remarkably slender, sharp at its end. Rostellar sac elongate, 0.194 long by 0.221 wide. Suckers discoid, 0.138 by 0.111. Neck absent.

Genital pores unilateral, situated in middle or a little posterior to middle of segment margins. Testes three in number, oval, 0.124–0.166 by 0.069–0.124, arranged in a transverse row, one poral and two aporal. Cirrus sac pyriform, 0.152–0.194 long by 0.055 wide, extending beyond longitudinal osmoregulatory canals. Internal seminal vesicle measuring 0.111–0.124 long by 0.055 wide and external seminal vesicle 0.180-0.193 long by 0.042–0.055 wide. Seminal receptacle large, dorsal to ovary, measuring 0.346 long by 0.124 wide. Vitelline gland weakly developed, 0.138 by 0.042, situated in posterior field of segment. Ovary transversely elongate, bilobate, 0.194–0.207 across. Eggs oval or spherical 0.042–0.053 long by 0.039 wide, surrounded by four thin envelopes. Onchosphered spherical, 0.028–0.032 in diameter; embryonic hooks 0.018 long.

Host: *Suncus myosurus swinhoei* (Blyth)

Site of infection: Small intestine.

Locality and date: Kuanyin Tsun, Kuanyin Hsiang, Taoyuan Hsien; October 9, 1986.

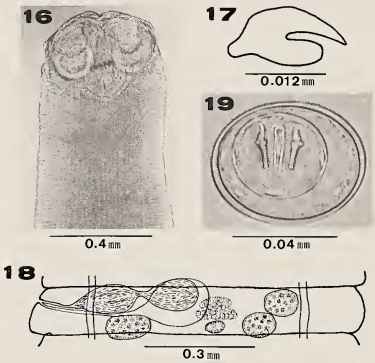
Type specimen: Holotype: NSU Lab. Coll. No. 8904.

Remarks: *Vampirolepis sunci* sp. n. most closely resembles *V. amamiensis* Sawada, 1986 [7] from *Crocidura horsfieldi watasei* in the number of rostellar hooks and the size of strobila. However, this species is distinguished from *V. amamiensis* by the smaller rostellar hooks (0.014 vs. 0.018), the shape of rostellar hooks (Fig. 15) and the longer embryonic hooks (0.018 vs. 0.011).

Vampirolepis sessilihamata sp. n. (Figs. 16–19)

On October 9, 1986, three brown musk shrews, *Suncus myosurus swinhoei,* were captured at Kuanyin Tsun, Kuanyin Hsiang, Taoyuan Hsien and

Fig. 15. Rostellar hook of *V. amamiensis*.



Figs. 16–19. *Vampirolepis sessilihamata* sp. n. 16: Scolex. 17: Rostellar hook 18: Mature segment, ventral view. 19: Egg.

were examined for cestodes. A large number of specimens of this cestode and the following *V. gracilistrobila* sp. n. were found in one of three shrews.

Description: Small-sized hymenolepidid; mature strobila with gravid segments, 15–35 in length by 0.8–0.9 in maximum width. Metamerism distinct, craspedote, margins slightly serrate. Mature and gravid segments markedly wider than long. Scolex 0.245 long by 0.350 wide, not distinctly set off from neck. Rostellum spherical, 0.056–0.063 in diameter, armed with a single circle of 10 thorn-shaped hooks measuring 0.018 long. Hook handle remarkably short, guard prominent, round at its end, shorter than blade; blade sharp at its end, curved toward guard. Rostellar sac slightly elongate, 0.168 by 0.105–0.119, extending past posterior margin of suckers. Suckers discoid, 0.126–0.133 in diameter.

Genital pores unilateral, located a little anterior to middle of segment margin. Testes three in number, ovoid, 0.091–0.098 long by 0.056–0.083 wide, arranged in a form of triangle, one poral and two aporal. Cirrus sac cylindrical, 0.161-0.210 long by 0.042–0.047 wide, extending beyond longitudinal osmoregulatory canals. Internal seminal vesicle 0.119–0.133 long by 0.042–0.056 wide, occupying almost whole of cirrus sac. External seminal vesicle 0.105–0.140 long by 0.049–0.077 wide. Ovary irregularly lobate, 0.056–0.077 by 0.028–0.035. Seminal receptacle well developed, 0.077–0.091 long by 0.049–0.056 wide. Vitelline gland weakly developed, compact, 0.028–0.042 by 0.021. Gravid uterus filling entire segment. Eggs slightly ovoid, 0.056–0.063 by 0.049–0.056, by four thin envelopes, with smooth surface. Onchospheres spherical, 0.032–0.035 in diameter; embryonic hooks 0.014–0.016 long.

Host: *Suncus myosurus swinhoei* (Blyth).

Site of infection: Small intestine.

Locality and date: Kuanyin Tsun, Kuanyin Hsiang, Taoyuan Hsien: October 9, 1986.

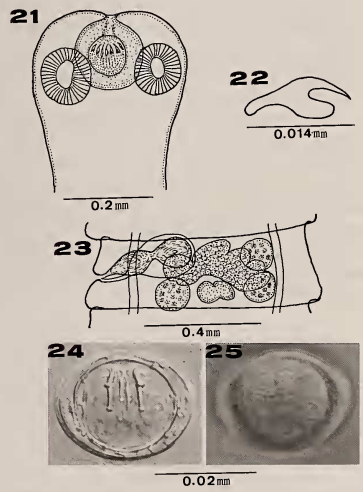
Type specimen: Holotype: NSU Lab. Coll. No. 8905; Paratypes No. 8906.

Remarks: In possessing ten rostellar hooks among the species of *Vampirolepis* occurring in Soricidae, this new species is related to the following six species; *V. parva* (Rausch and Kuns, 1950) [8], *V. blarinae* (Rausch and Kuns, 1950) [8], *V. lineola* (Oswald, 1951) [9], *V. virilis* (Voge, 1955) [10], *V. bahli* (Singh, 1958) [11] and *V. petrodromi* (Baer, 1933) [12]. Of these, this new cestode closely resembles *V. bahli* in the length of rostellar hooks. However, it differs from *V. bahli* in the shape of rostellar hooks (Fig. 20).

Fig. 20. Comparison of rostellar hook shapes among seven species of cestodes. F: *V. parva*. G: *V. blarinae*. H: *V. lineola*. I: *V. virilis*. J: *V. bahli*. K: *V. sessilihamata* sp. n. L: *V. pertrodromi*.

Vampirolepis gracilistrobila sp. n.
(Figs. 21–25)

Description: Small-sized hymenolepidid: worm length 25–30 and maximum width 0.7–0.8. Metamerism distinct, segment margin slightly serrate. Mature gravid segments wider than long. Scolex round, 0.140–0.280 long by 0.252–0.315 wide, not sharply demarcated from neck region. Rostellum spherical, 0.070 long by 0.084 wide, armed with a single row of 33 thorn-shaped hooks measuring 0.014 long. Hook handle short; guard prominent, round at its end, shorter than blade; blade sharp at its end. Rostellar sac spherical, 0.140 in diameter, extending nearly to posterior margin of suckers. Suckers discoid, 0.098–0.105 in diameter.



Figs. 21–25. *Vampirolepis gracilistrobila* sp. n. 21: Scolex. 22: Rostellar hook. 23: Mature segment, ventral view. 24: Egg. 25: Surface of egg, showing polar filaments.

Genital porse unilateral and located a little posterior to middle of segment margins. Testes three in number, subspherical, 0.070–0.077 long by 0.056–0.063 wide, arranged in a form of triangle, one poral and two aporal. Cirrus sac cylindrical, 0.084–0.091 long by 0.014–0.021 wide, extending beyond longitudinal osmoregulatory canals. Internal seminal vesicle 0.077–0.084 long by 0.014–0.021 wide, occupying almost whole of cirrus sac. External seminal vesicle 0.077–0.084 long by 0.035–0.049 wide. Seminal receptacle well developed, 0.070–0.105 long by 0.056–0.084 wide. Ovary penta- or hexa-lobate, 0.053–0.063 across. Uterus arising directly from ovarian lobes as a lobe sac, gradually enlarging, filling all available space in senile segments. Eggs subspherical, 0.046 long by 0.032–0.035 wide, with at each pole a round projection provided with polar filaments. Onchospheres spherical, 0.025–0.032 in diameter; embryonic hooks 0.014 long.

Host: *Suncus myosurus swinhoei* (Blyth).

Site of infection: Small intestine.

Locality and date: Kuanyin Tsun, Kuanyin Hsiang, Taoyuan Hsien; October 9, 1986.

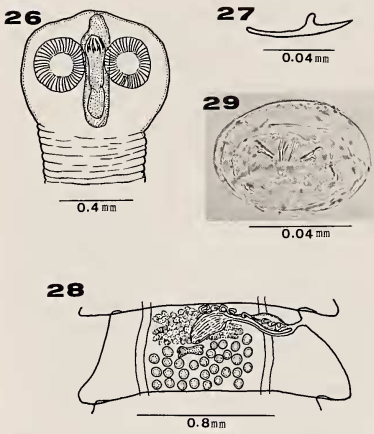
Type specimen: Holotype: NSU Lab. Coll. No. 8907; Paratypes: 8908.

Remarks: The present new species most closely resembles *V. notoensis* Sawada, 1986 [7] from *Crocidura dsinezumi chisai* in the size and form of rostellar hooks, and the arrangement of testes. However, it differs from *V. notoensis* in the larger size of strobila (25–32 long by 0.7–0.8 wide vs. 4.5 long by 0.5 wide), the larger number of rostellar hooks (33 vs. 23), the position of genital pores (located a little posteior to middle of segment vs. located a little anterior) and the form of ovary (penta- or hexa-lobate vs. transversely elongate and bilobate).

Choanotaenia Railliet, 1896
Choanotaenia (Choanotaenia) tubirostellata sp. n.
(Figs. 26–29)

A large number of specimens of this cestode were obtained from six Yamashina's mole-shrews, *Anourosorex squamipes yamashinai,* captured at Tsuifeng, Lenai Hsiang Nantou Hsien, on October 8, 1986.

Description: Medium-sized dilepidid, mature worm length 34–39 and maximum width 1.4–1.6. Anterior segments much broader than long, but



Figs. 26–29. *Choanotaenia (Choanotaenia) tubirostellata* sp. n. 26: Scolex. 27: Rostellar hook. 28: Mature segment, dorsal view. 29: Egg.

gradually proportion reversed, posterior ones being much longer than broad. Scolex spherical, 0.567–0.692 long by 0.830–1.042 wide, distinctly set off from neck. Suckers round, 0.249–0.290 in diameter. Rostellum cylindrical, 0.401 long by 0.097–0.111 wide, armed with a single row of 18 hooks measuring 0.060–0.063 long. Hook handle slender; guard small, round at its end, remarkably shorter than blade; blade sharp at its end. Rostellar sac cylindrical, extending beyond posterior margins of suckers, measuring 0.443–0.484 long by 0.166–0.193 wide.

Genital pores irregularly alternate, located at extreme anterior margins of segment. Testes oval or spherical, numbering about 29–32, lying in posterior half of segment. Vas deferens much coiled, located in anterior field of segment, and joining to posterior edge of cirrus sac. Cirrus sac pyriform, 0.105 long by 0.035 wide. Cirrus unarmed. Ovary well developed, irregularly lobate, composed of a number of follicles, pretesticular, lying in anterior field of segment, measuring 0.252–0.259 across. Vagina opening just posterior to genital atrium, extending to median field, parallel to cirrus sac, then enlarging, forming a seminal receptacle measuring 0.180–0.249 long by 0.063 wide. Vitelline gland weakly developed, bilobate, 0.105–0.133 long by 0.028–0.035 wide, situated posterior to ovary. Eggs subspherical 0.053–0.074 long by 0.028–0.035 wide, surrounded by four thin envelopes. Onchospheres subspherical, 0.028–0.035 long by 0.018–0.021 wide; embryonic hooks 0.011–0.014 long.

Host: *Anourosorex squamipes yamashinai* Kuroda.

Site of infection: Small intestine.

Locality and date: Tsuifeng, Lenai Hsiang, Nantou Hsien; October 8, 1986.

Type specimen: Holotype: NSU Lab. Coll. No. 8909; Paratypes No. 8910.

Remarks: So far as known to the authors, five species of *Choanotaenia* (*Choanotaenia*) Matevosian, 1954 have been recorded from mammals: *C.*(*C.*)*nebraskensis* Hansen, 1950 [13], *C.*(*C.*)*peromysci* (Erickson, 1938) [14], *C.*(*C.*)*sciuriola* Harwood et Cooke, 1949 [15], *C.*(*C.*)*scutigera* (Duj., 1845) [16] and *C.*(*C.*)*spermophili* (McLeod, 1933) [17]. The present new species most closely resembles *C.*(*C.*)*sciuricola* from *Sciurus niger* in the shape of rostellar hooks and the number of testes. However, it differs from *C.*(*C.*)*sciuricola* in the larger rostellum (0.507–0.692 long by 0.830–1.043 wide vs. 0.26 long by 0.32 wide), the smaller number of rostellar hooks (18 vs. 22), the longer rostellar hooks (0.060–0.063 vs. 0.038) and the smaller onchospheres (0.028–0.035 by 0.018–0.021 vs. 0.0547).

ACKNOWLEDGMENTS

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